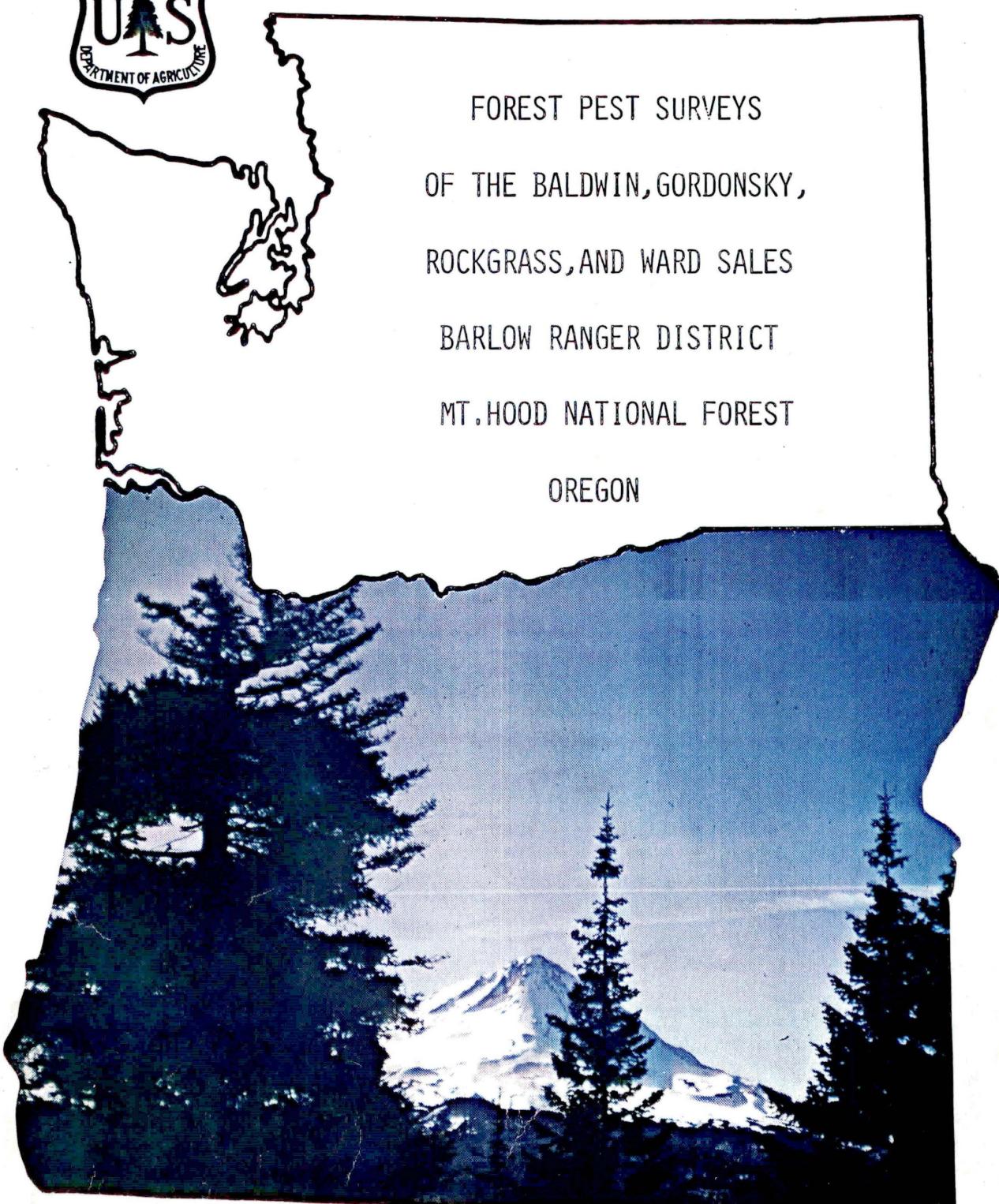


# Forest Pest Management

## Pacific Northwest Region



Forest Pest Surveys in the Baldwin, Gordonsky,  
Rockgrass, and Ward Timber Sales,  
Barlow Ranger District, Mt. Hood National Forest, Oregon

by

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Summary

In the summer of 1982, four proposed timber sale areas, totalling 6,290 acres, were surveyed on the ground for extent and location of major forest pests. Dwarf mistletoes were the most frequently encountered forest pests, infecting larch, Douglas-fir, and ponderosa pine on 29% of the Baldwin, 58% of the Gordonsky, and 20% of the Ward Sales. Laminated root rot, potentially the most serious forest pest in the proposed sale areas, was found affecting primarily grand fir, Douglas-fir, and mountain hemlock in 4% of the Baldwin, 34% of the Gordonsky, 14% of the Rockgrass, and 6% of the Ward Sales. Heartrot, caused by the Indian paint fungus, was common in all surveyed areas where old-growth grand fir, noble fir, and mountain hemlock were prevalent. Scattered mortality caused by other root diseases and bark beetles was found occasionally in all areas. Disease management strategies are discussed for each pest by sale area.

Introduction

Several forest pests are causing extensive mortality, growth loss, cull, and loss of site productivity in East Side mixed conifer forest types in Oregon and Washington. Damage caused by many forest pests will decrease as old-growth is converted to young, vigorous stands with more intensive management. However, if some forest diseases are ignored or inappropriately dealt with, losses may continue and even increase in future rotations. Disease management guidelines are available to the forest manager to prevent this from happening.

Root diseases are insidious, difficult to detect, and significantly damaging in mixed conifer types (Filip and Goheen 1983). Unlike most forest pests, most root diseases do not "leave the site" following stand harvest but can remain infective for up to 50 years in residual stumps and large roots of harvested, infected trees. Disease-causing fungi spread from infected stumps and roots to susceptible regeneration via root contacts and grafts. Growth loss and mortality may occur on infested sites before trees reach merchantability, rendering these areas permanently unproductive. Fortunately, many conifer species show some resistance to infection and mortality caused by specific root pathogens, hence they can be favored during normal silvicultural operations as a method of reducing future damage (Hadfield and Johnson 1977).

Dwarf mistletoes are easy to detect and are not difficult to control with normal silvicultural operations. Unlike most root diseases, dwarf mistletoes die with their hosts. However, in many East Side stands, mistletoe-infected shelterwood or seed trees are retained and can infect susceptible regeneration, especially after crop trees are 3 feet tall or 10 years old. Dwarf mistletoe causes growth loss (up to 60% in severely infected larch and Douglas-fir), and

eventually mortality, especially in larch and Douglas-fir. Severe dwarf mistletoe infections render hosts particularly susceptible to other pests such as bark beetles and root diseases.

Heartrots, primarily caused by the Indian paint fungus, result in substantial cull in true fir species, particularly grand and white fir, and mountain hemlock. Suppressed advanced true fir and mountain hemlock regeneration with true fir or hemlock overstories is particularly susceptible to infection. Amount of subsequent heartrot is directly proportional to tree age and severity of wounding, hence damage in future stands can be reduced by lowering rotation ages and limiting wounding during stand entries.

Large bark beetle epidemics are not as common in the mixed conifer types as they are in the pine-dominated types. However, as stands mature, mortality caused by bark beetles increases, especially if other pests, particularly root diseases, are already present and contributing to tree decline. Bark beetle-caused mortality can be minimized if stands are intensively managed and rotations are short.

Barlow District silviculturists, concerned by the presence of and mortality caused by several forest pests, requested the assistance of Forest Pest Management to aid in measuring the extent and location of major forest pests in four proposed timber sale areas (Figure 1).

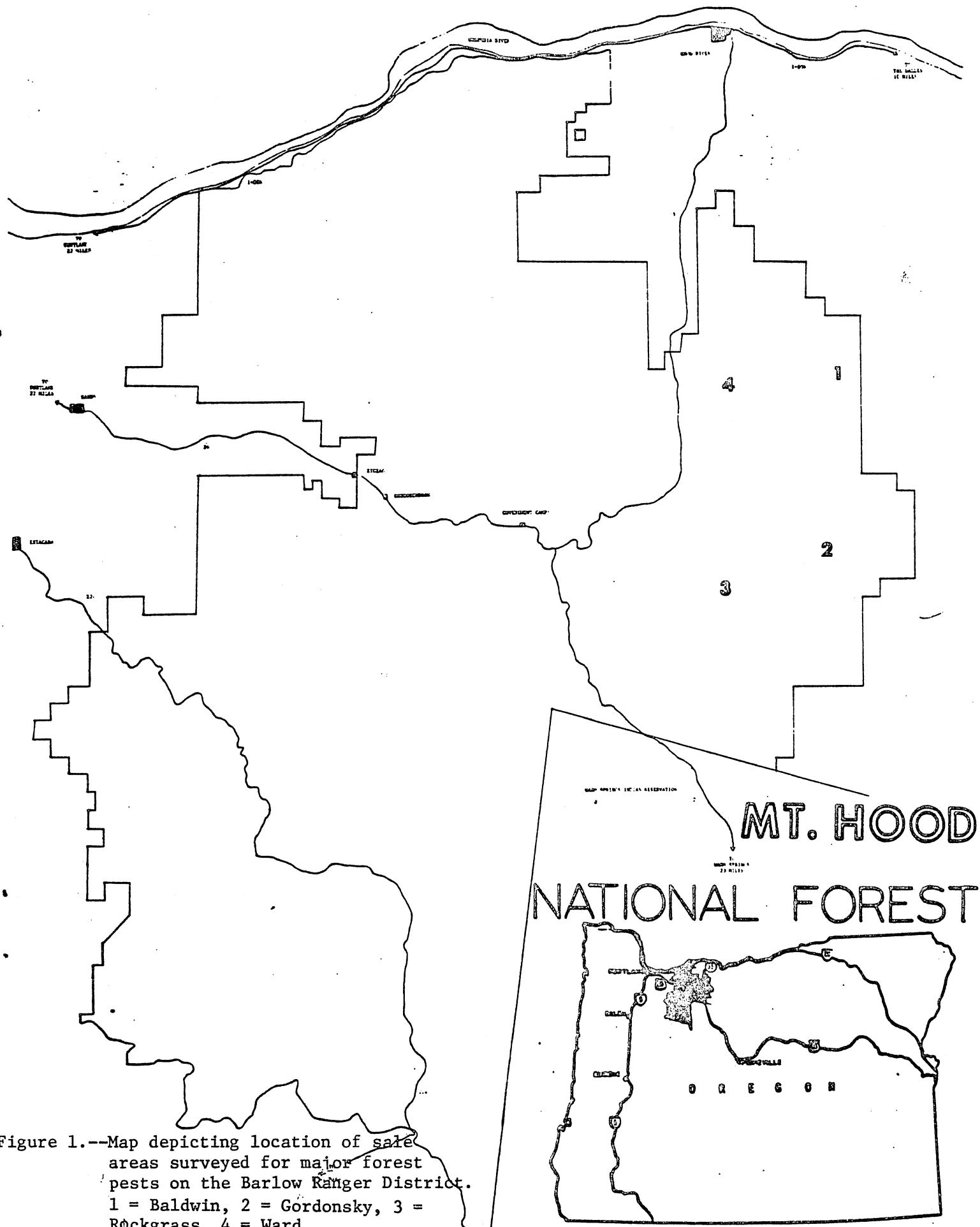


Figure 1.--Map depicting location of survey areas surveyed for major forest pests on the Barlow Ranger District.  
1 = Baldwin, 2 = Gordonsky, 3 = Rockgrass, 4 = Ward.

### Objectives

Objectives of this evaluation were to:

1. Determine the general location and percent of area affected by major forest pests in four sale areas.
2. Develop management alternatives, based on the collected data, for minimizing impact caused by these forest pests.

### Methods

A line intercept survey method modified from Bloomberg and others (1980) was used to estimate percentage of area affected by forest pests in all four sale areas. Transects were established with the aid of topographic maps and aerial photos at 10-chain (660') intervals across each sale area. A model M-25 hip-chain was used to measure transect lengths and position of affected areas. Affected areas were determined either (1) on an individual tree basis by estimating the rooting zone of an affected tree based on its DBH, or (2) in large affected areas by noting the beginning (first symptomatic trees) and ending (last symptomatic trees) of the affected area along the transect. The proportion of the total line length that fell within affected areas was determined and used to estimate percentage of area affected. Trees within approximately two chains of either side of the transect were examined. Lengths of transects that fell within unforested areas (natural openings, roads, or recent clear-cuts) and abrupt changes in forest type and topography were also recorded.

Each affected area was examined for forest pests as follows: Root diseases were identified as to causal species by (1) excavating the root collars and two major roots, (2) examining the bark surface for ectotrophic mycelium of *Phellinus weiri*, (3) removing the bark and examining for mycelial fans of *Armillaria mellea*, and (4) chopping into rootwood and examining for laminated decay with setal hyphae caused by *P. weiri*, yellow-stringy decay caused by *A. mellea*, white-stringy decay caused by *Fomes annosus*, or black-stained sapwood caused by *Ceratocystis wageneri*.

Dwarf mistletoes were identified by the presence of witches' brooms and aerial plants in infected trees. Dwarf mistletoe severity was rated 0-6 using Hawks-worth's 6-class system; zero meaning no mistletoe and six indicating very severe infection. Bark beetles were identified by removing a section of bark at breast height and examining galleries. Presence of heartrot was recorded by transect position when conks were visible on affected trees. Because conks are not reliable indicators for the total number of trees with infection or heartrot, it was not possible to estimate percentage of area affected by heartrots.

A map of each sale area was constructed showing locations of transects, affected areas, and major topographical features.

### Results and Discussion

In the summer of 1982, all four sale areas, totalling 6,290 acres, were surveyed for forest pests by establishing 127,533 yards (72.5 miles) of transects. The surveys were completed in 6 weeks by a crew of two.

#### Baldwin Sale Area

Baldwin Sale Area, 2,500 acres, is composed primarily of two forest types. Stands covering most (75%) of the area can be classified as uneven-aged mixed conifer, comprised of grand fir, Douglas-fir, western larch, and ponderosa pine. Grand fir predominates in draws and canyons, especially northerly aspects. Ponderosa pine is most abundant on ridgetops and southerly exposures. Nearly pure ponderosa pine stands, generally composed of poles and small sawtimber, are found in 14% of the area. Natural openings, roads, and recent clearcuts constitute the remaining 11% of the area.

Nearly 56,260 yards (32 miles) of transects were established across the area. The most abundant diseases were the dwarf mistletoes which were found affecting trees over 29% of the area (Table 1). Western dwarf mistletoe (*Arceuthobium campylopodium*) was found commonly on ponderosa pine; generally, trees were lightly infected. More damaging were larch dwarf mistletoe (*A. laricis*) and Douglas-fir dwarf mistletoe (*A. douglasii*). Mortality caused by both of these species of mistletoes was common throughout the entire mixed conifer type as were living, severely infected trees. Maps were not constructed showing locations of dwarf mistletoes because virtually every acre in the sale area had dwarf mistletoe-infected trees.

Table 1.--Percentage of area affected by dwarf mistletoe, root diseases, and bark beetles as determined by line intercept survey in the Baldwin Timber Sale, Barlow R.D., 2,600 acres.

Forest Type	Total Yardage	Affected Yardage			
		Dwarf Mistletoe	Laminated Root Rot	Other <sup>1</sup> / Root Rots	Bark Beetles
Mixed Conifer	42,550(75) <sup>3</sup> /	12,448(29)	1,970(5)	195(<1)	761(2)
Ponderosa	7,682(14)	1,890(25)	6(<1)	6(<1)	72(<1)
Openings <sup>2</sup> /	6,028(11)	---	---	---	---
Total	56,260(100)	14,338(29)	1,976(4)	201(<1)	833(2)

<sup>1</sup>/ Includes root rots caused by *Armillaria mellea* and *Fomes annosus*.

<sup>2</sup>/ Includes natural openings, roads, and recent clearcuts.

<sup>3</sup>/ Percentages are in parentheses.

Laminated root rot, caused by the fungus *Phellinus weiri*, was associated with mortality in about 5 percent of the mixed conifer type (Table 1). In every case, mortality centers were found in draws, especially on northerly aspects where grand fir and Douglas-fir, the most heavily damaged species, predominated. No mortality due to *P. weiri* was observed in either western larch or ponderosa pine where these species were associated with infected fir.

Virtually the entire Eight-mile Creek Canyon is infested with *P. weiri* (Figure 2). Several large mortality centers were noted on most transects across this canyon. Since mortality and living symptomatic trees represent about half of the number of trees actually infected, the entire Eight-mile Creek Canyon can be considered infested because of the close proximity of mortality centers to one another. Less than 1% of the ponderosa type has laminated root rot; only isolated Douglas-fir were affected within this type.

Root diseases caused by *Armillaria mellea* and *Fomes annosus* were found in less than 1% of the area. Damage occurred in isolated patches of weakened or wounded trees, primarily grand fir. In nearly every case, evidence of fir engravers (*Scolytus ventralis*) was found in root-diseased trees. Mortality caused by other bark beetles, primarily pine engravers (*Ips* spp.) in small diameter pine and mountain pine beetle (*Dendroctonus ponderosae*) in pole- to sawtimber-size pine, was infrequent (2% of the area), occurring in weakened individual trees or scattered groups of pine on dry ridgetops.

Heartrot, caused by the Indian paint fungus, *Echinodontium tinctorium*, was common where old-growth grand fir grew, especially along watercourses where conky trees were abundant. Infection and decay caused by *E. tinctorium* have been shown to be most common on wetter sites characterized by fir overstories, northerly aspects, and lower topographical positions.

#### Recommended Stand Treatments

1. Place regeneration cuts in as much of the sale area as possible to remove affected trees and prevent future stand damage caused by dwarf mistletoes, bark beetles, Indian paint fungus, and root diseases other than laminated root rot.

(a) If mistletoe-infected seed trees or shelterwood trees need to be retained, promptly remove overstory before susceptible regeneration reaches 3 feet tall or 10 years old, whichever occurs first. Pine dwarf mistletoe affects only pine regeneration, larch dwarf mistletoe only larch regeneration, and Douglas-fir dwarf mistletoe only Douglas-fir regeneration.

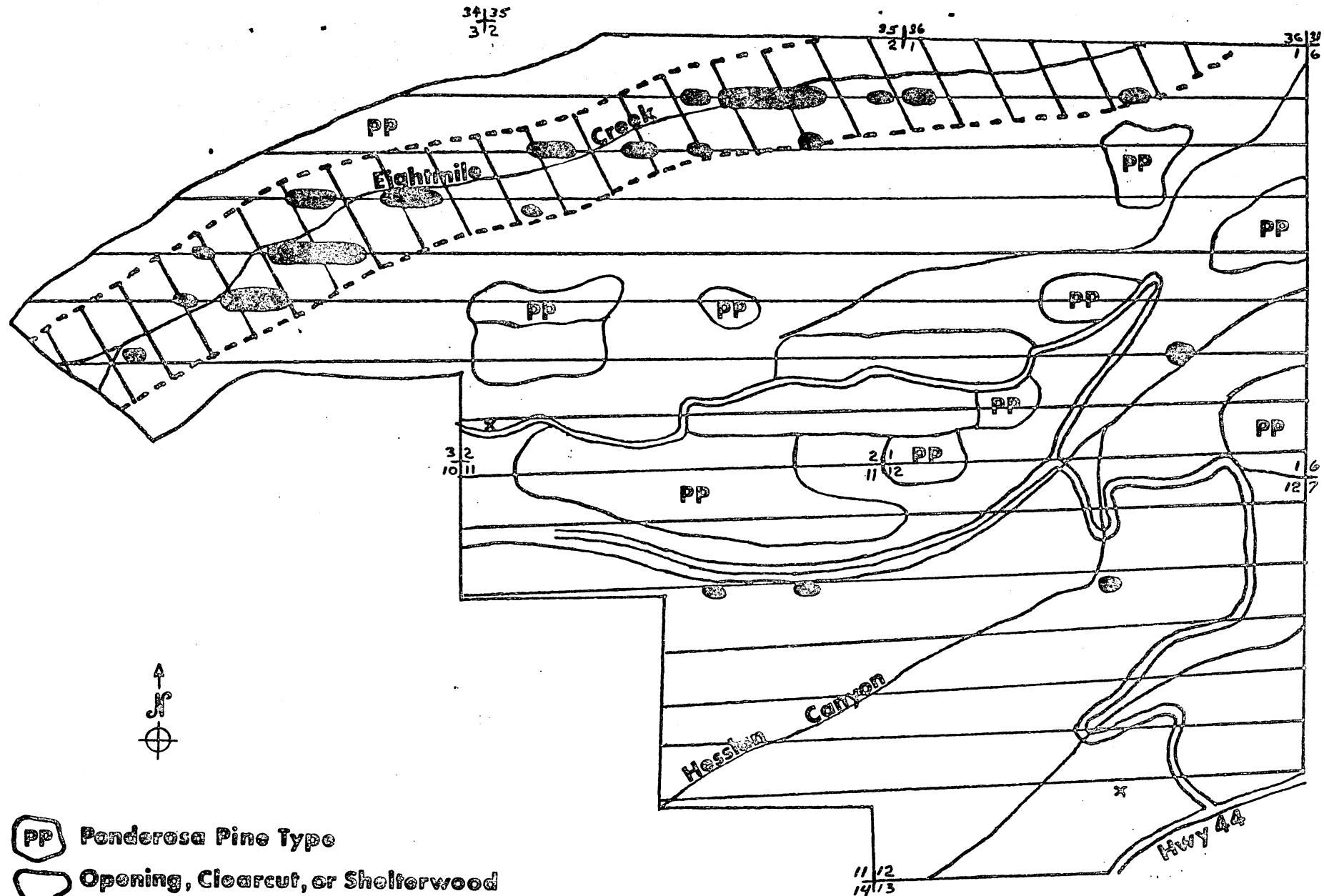
(b) In areas where advanced grand fir regeneration might be retained, hazard rate potential crop trees for present rates of infection and decay caused by the Indian paint fungus. The decision to retain or destroy advanced grand fir regeneration should be based on the estimated amount of decay present.

2. In laminated root rot areas, particularly Eight-mile Creek Canyon, harvest as much of the merchantable grand fir and Douglas-fir as possible. Unmerchantable grand and Douglas-fir including all advanced regeneration should be destroyed.

(a) Retain only pine and larch (preferably non-mistletoe-infected trees) in the overstory to serve as seed trees and understory to serve as crop trees. These two species, especially pine, are resistant to *P. weiri*.

(b) Plant only larch and pine where seed trees or advanced regeneration is poorly stocked.

(c) Favor larch and pine and remove all Douglas-fir and grand fir when precommercially thinning.



**PP Ponderosa Pine Type**

## Opening, Clearcut, or Shelterwood

## Laminated Root Rot Mortality

### III Infected Area

## Transects

Figure 2.-- Map of the proposed Baldwin Sale (T. 2 S., R. R. 11 E., secs. 1, 2, 3, 11, 12) showing location of major areas affected by laminated root rot.

### Gordonsky Sale Area

Gordonsky Sale Area, 1,260 acres, is composed of uneven-aged stands of mixed grand fir, Douglas-fir, western larch, ponderosa pine, and western white pine, with some western redcedar in creek bottoms. Most of the sale area is located on a fairly steep slope on the north side of Little Badger Creek.

Over 23,800 yards (13.5 miles) of transects were established across the area. As in the Baldwin Sale Area, the most abundant (58% of area infested) forest pests were dwarf mistletoes infecting western larch and Douglas-fir (Table 2). Mortality and severe infections in living trees caused by dwarf mistletoe were common throughout the sale area. Because virtually the entire sale area exhibited some degree of dwarf mistletoe, maps were not constructed showing locations of infested areas.

Table 2.--Percentage of area affected by dwarf mistletoe, root diseases, and bark beetles as determined by line intercept survey in the Gordonsky Sale Area, Barlow, R.D., 1,260 acres.

Forest Type	Total Yardage	Affected Yardage			
		Dwarf Mistletoe	Laminated Root Rot	Other <sup>1/</sup> Root Rots	Bark Beetles
Mixed Conifer	23,625(99) <sup>3/</sup>	13,595(58)	7,954(34)	79(<1)	158(<1)
Ponderosa	80(<1)	0	0	0	0
Openings <sup>2/</sup>	96(<1)	---	-----	-----	---
Total	23,801(100)	13,595(58)	7,954(34)	79(<1)	158(<1)

<sup>1/</sup> Includes root rots caused by *Armillaria mellea* and *Fomes annosus*.

<sup>2/</sup> Includes natural openings, roads, and recent clearcuts.

<sup>3/</sup> Percentages are in parentheses.

Laminated root rot undoubtedly poses the most serious threat to future productivity in the sale area. Mortality centers were found in 34% of the sale area and were distributed over all but the extreme eastern portion (Figure 3). The entire sale area, save perhaps the extreme eastern portion, can be considered infected by *P. weiri* since mortality centers are so numerous. Only grand fir and Douglas-fir were found to be damaged.

Root diseases caused by *Armillaria mellea* and *Fomes annosus* were found in less than 1% of the area, primarily on scattered weakened or injured grand fir. Fir engravers were commonly found in association with root diseases. Mountain pine beetle-caused mortality was noted infrequently in ponderosa pine. Heart-rot, as indicated by conks of the Indian paint fungus, was common in old-growth grand fir along Little Badger Creek.

Recommended Stand Treatment

1. In all but the extreme eastern portion of the sale area, arrange cutting units to harvest as much of the merchantable grand fir and Douglas-fir as possible. All unmerchantable grand and Douglas-fir, including advanced regeneration, should be destroyed.
2. Retain only larch, ponderosa pine, and white pine in the overstory to serve as seed trees and understory to serve as crop trees.
3. If mistletoe-infected seed trees need to be retained, remove overstory before susceptible regeneration becomes 3 feet tall or 10 years old, whichever occurs first. Larch dwarf mistletoe only affects larch regeneration, and Douglas-fir dwarf mistletoe only affects Douglas-fir regeneration.
4. Plant only larch, ponderosa pine, or white pine where seed trees or advanced regeneration is poorly stocked. If planting white pine, use blister-rust-resistant stock if infection hazard is high. Contact FPM for assistance in determining hazard.
5. Favor larch and pine and destroy all Douglas-fir and grand fir during pre-commercial thinning entries.

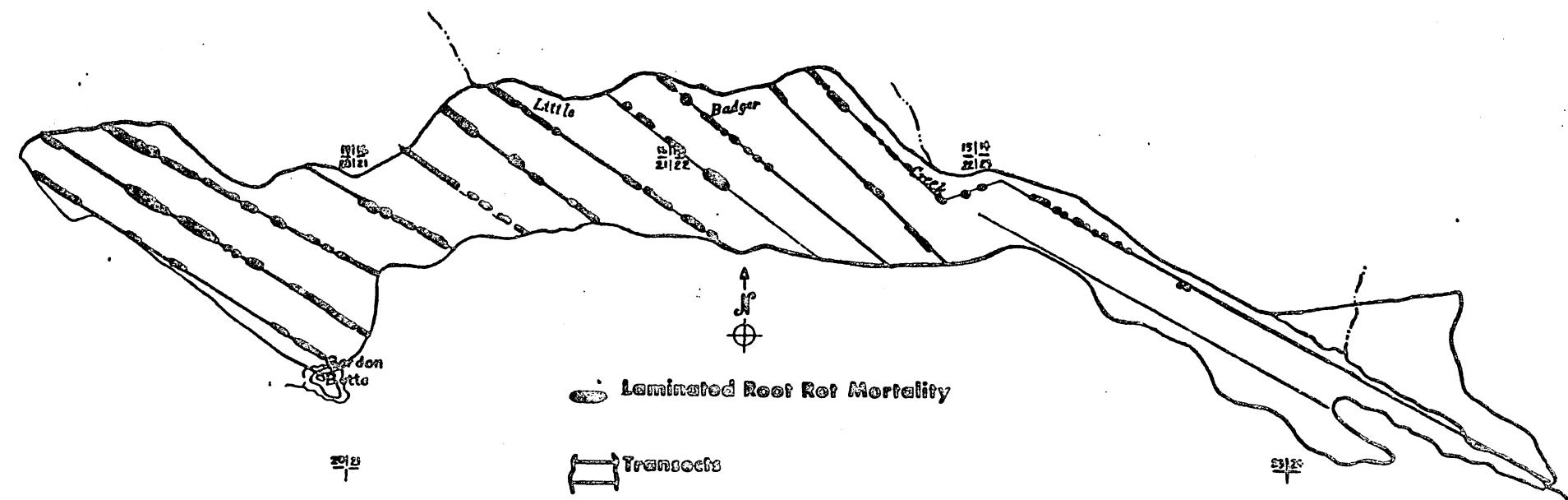


Figure 3.-- Map of the proposed Gordonsky Sale (T. 3 S., R. 11 E., secs. 15, 16, 17, 20, 21, 22, 23, 24) showing location of major areas affected by laminated root rot.

### Rockgrass Sale Area

Rockgrass Sale Area, 990 acres, is a high elevation site (4,800 to 5,400 feet). Stands are composed primarily of old-growth mountain hemlock and noble fir with scattered Engelmann spruce, subalpine fir, lodgepole pine, and western white pine.

Nearly 18,800 yards (10.7 miles) of transects were established across the area. Laminated root rot was found to be the most damaging pest in the area, particularly in the northeast portion of the stand (Table 3, Figure 4). Mortality and windthrow caused by *P. weiri* were most common in mountain hemlock, but damage occurred to a lesser extent in noble fir. No mortality caused by laminated root rot was observed in other species.

Table 3.--Percentage of area affected by dwarf mistletoe, root diseases, and bark beetles as determined by line intercept survey in the Rockgrass Sale Area, Barlow, R.D., 990 acres.

Forest Type	Total Yardage	Affected Yardage			
		Dwarf Mistletoe	Laminated Root Rot	Other <sup>1</sup> / Root Rots	Bark Beetles
Mixed Conifer Openings <sup>2</sup> /	18,694(99) <sup>3</sup> / 105(1)	0	2,657(14)	292(2)	136(<1) 0
Total	18,799(100)	0	2,657(14)	292(2)	136(<1)

<sup>1</sup>/ Includes root rots caused by *Armillaria mellea* and *Fomes annosus*.

<sup>2</sup>/ Includes natural openings, roads, and recent clearcuts.

<sup>3</sup>/ Percentages are in parentheses.

Damage caused by other root pathogens, including *Armillaria mellea* and *Fomes annosus*, and bark beetles, primarily mountain pine beetle in white pine and lodgepole pine, occurred infrequently (2 and <1% of the area, respectively). Dwarf mistletoe infection appeared to be absent from the area.

Much of the old-growth noble fir and mountain hemlock throughout the area had conks of the Indian paint fungus, indicating extensive decay. Although this fungus is not as damaging to noble fir as it is to grand fir or mountain hemlock, a high amount of cull should be expected. In much of the area, advanced noble fir regeneration was present. Much of the advanced regeneration was more than 50 years old and had been suppressed for several decades, hence infection by Indian paint fungus is probably widespread in these trees.

Recommended Stand Treatments

1. Place regeneration cuts in as much of the sale area as possible to remove affected trees and reduce damage caused by bark beetles, Indian paint fungus, and root diseases other than laminated root rot. In areas where advanced noble fir regeneration might be retained, select groups with an adequate stocking of crop trees that are unwounded, rapid growing, have good live crown ratios, and therefore, are unlikely to be infected with the Indian paint fungus.
2. In laminated root rot areas, arrange cutting units to harvest as much of the merchantable mountain hemlock and noble fir as possible. Destroy all unmerchantable hemlock including advanced regeneration.
  - (a) Retain lodgepole pine and white pine as the first choice for seed trees and crop trees. Second choices would be noble fir, subalpine fir, and Engelmann spruce. Lodgepole and white pine are more resistant to laminated root rot than fir or spruce.
  - (b) Plant only pine where seed trees or advanced regeneration is poorly stocked. Use blister-rust-resistant white pine stock if infection hazard is high. Check with FPM for assistance in determining hazard.
  - (c) Favor pine first and fir and spruce second during future precommercial thinning activities.

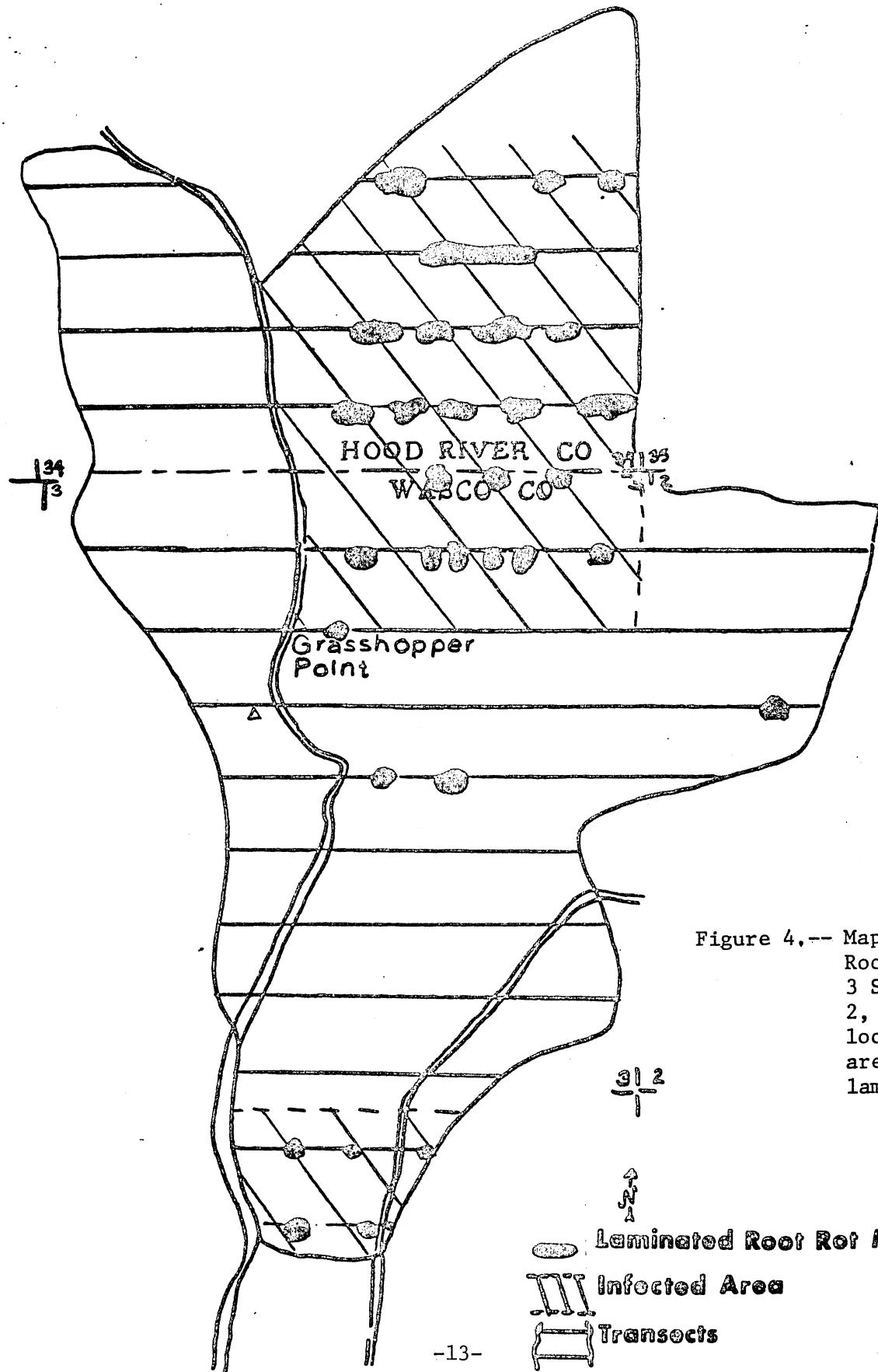


Figure 4.-- Map of the propose Rockgrass Sale (T. 3 S., R. 10 E., se 2, 3, 10) showing location of major areas affected by laminated root rot.

### Ward Timber Sale Area

Ward Timber Sale Area, 1,440 acres, is another higher elevation site (4,300 to 5,400 feet). Stands are composed of many conifer species including noble fir, grand fir, Pacific silver fir, Engelmann spruce, subalpine fir, lodgepole pine, western white pine, western larch, and Douglas-fir. Much of the timber has been harvested with clearcuts (7% of area) or shelterwood cuts (about 20%) (Figure 5).

Nearly 28,675 yards (16.3 miles) of transects were established across the area. Larch dwarf mistletoe was the most abundant disease, affecting 20 percent of the area (Table 4) and was most damaging in old-growth trees. Maps were not constructed since virtually the entire area containing larch was affected.

Table 4.--Percentage of area affected by dwarf mistletoe, root diseases, and bark beetles as determined by line intercept survey in the Ward Timber Sale, Barlow R.D., 1,440 acres.

Forest Type	Total Yardage	Affected Yardage			
		Dwarf Mistletoe	Laminated Root Rot	Other <sup>1/</sup> Root Rots	Bark Beetles
Mixed Conifer Openings <sup>2/</sup>	26,771(93) <sup>3/</sup> 1,902(7)	5,378(20) -	1,577(6) -	218(<1) -	349(1) -
Total	28,673(100)	5,378(20)	1,577(6)	218(<1)	349(1)

<sup>1/</sup> Includes root rots caused by *Armillaria mellea* and *Fomes annosus*.

<sup>2/</sup> Includes natural openings, roads, and recent clearcuts.

<sup>3/</sup> Percentages are in parentheses.

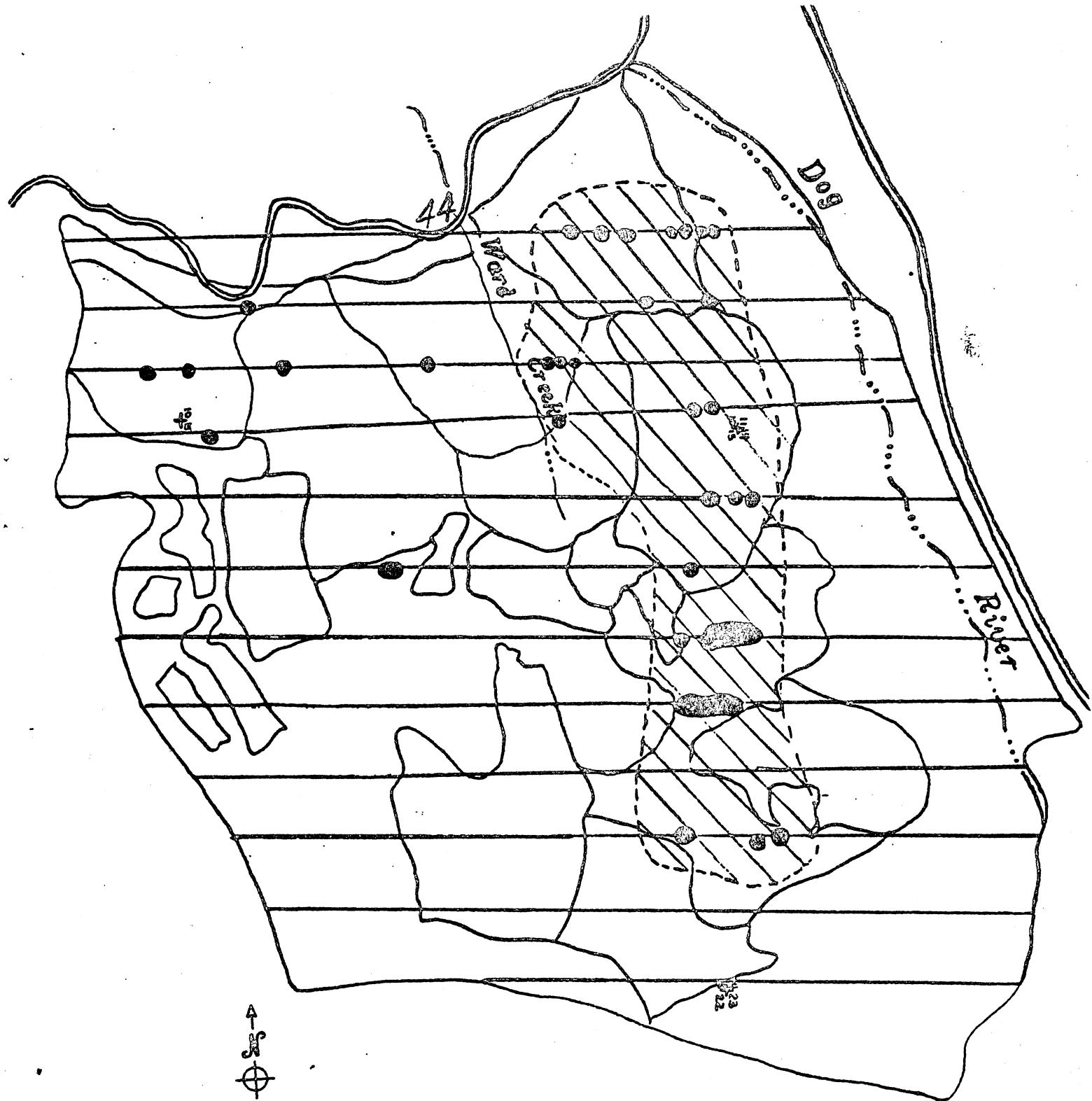
Laminated root rot was found causing mortality in 6 percent of the area. Most mortality centers were located in the eastern portion of the area between Ward Creek and Dog River (Figure 5). Mortality and windthrow were common in grand fir, Douglas-fir, and noble fir in this area. Some mortality caused by *P. weiri* was observed in larch, spruce, and subalpine fir. Scattered mortality centers were found in the northwestern part of the area. Probably more infection occurs in the sale area than was evident since much of the timber has been harvested, and some of the stumps were infected in clearcuts.

Other root diseases, including those caused by *Armillaria mellea* and *Fomes annosus*, were found infrequently (less than 1% of the area) in scattered individual trees, primarily grand and subalpine fir.

Some bark beetle activity occurred, mainly at the edges of clearcuts or within shelterwood units where windthrow was common. Engelmann spruce beetle (*D. rufipennis*) activity was evident in live standing trees adjacent to windthrow.

Recommended Stand Treatments

1. In laminated root rot areas, particularly between Ward Creek and Dog River, arrange cutting units to harvest as much of the merchantable noble and grand fir as possible. Destroy all unmerchantable grand fir including advanced regeneration.
  - (a) Retain lodgepole pine and white pine as the first choices for seed trees and crop trees. Pines are more resistant to laminated root rot than larch, spruce, or true fir. Grand fir and Douglas-fir are the most susceptible.
  - (b) Plant pine first and larch or spruce second where seed trees or advanced regeneration is poorly stocked. Lodgepole pine, where planted in clear-cuts, appears to be growing well. If white pine is planted, use blister-rust-resistant stock only if infection hazard is high. Contact FPM for assistance in determining risk of hazard.
  - (c) Favor pine first and spruce and larch second during future thinning activities.
2. In areas where true fir regeneration might be retained, select groups with an adequate stocking of crop trees that are unwounded, rapid growing, have good live crown ratios, and therefore, are unlikely to be infected with the Indian paint fungus.
3. If mistletoe-infected seed trees need to be temporarily retained, remove or destroy them before susceptible regeneration reaches 3 feet tall or 10 years old, whichever occurs first. Larch dwarf mistletoe will affect larch and sub-alpine fir regeneration.
4. Harvest windthrow within 1 year to prevent buildup of bark beetle populations and attacks in living adjacent trees, especially spruce.



-  **Opening, Clearcut, or Shelterwood**
-  **Laminated Root Rot Mortality**
-  **Infected Area**
-  **Transects**

Figure 5.-- Map of the proposed Ward Sale (T. 2 S., R. 10 E., secs. 9, 10, 11, 14, 15, 16, 22, 23) showing location of major areas affected by laminated root rot.

### Conclusions

The following implications should be considered when formulating silvicultural prescriptions for the Baldwin, Gordonsky, Rockgrass, and Ward Sale Areas:

1. No Treatment. Growth loss, cull, and mortality caused by root diseases, dwarf mistletoes, heartrots, and bark beetles will increase in all sale areas if treatments are delayed.
2. Sanitation-Salvage Operations. Wood that normally would be lost from heartrots and mortality caused by dwarf mistletoes and bark beetles will be saved by sanitation-salvage operations. However, in stands with laminated root rot, mortality and windthrow will continue and probably increase on the site. Stands with a moderate or light amount of root disease, including *Armillaria* and *annosus* root rots, may become seriously damaged if salvage operations continue for several decades with no other treatments.
3. Seed Trees, Shelterwood, or Thinning Operations. Most diseased or insect-infested trees can be removed in one or two operations. Disease and insect-caused mortality will decrease and windthrow will be minimized if (a) care is taken to leave uninfected residuals, (b) grand fir, Douglas-fir, and mountain hemlock are discriminated against in root-diseased stands, and (c) wounding in residual trees and advanced regeneration, especially true fir, is minimized.
4. Clearcutting Operations. Within harvest units, all diseased or insect-infested trees, at least merchantable ones, can be removed in one operation. Disease and insect-caused mortality will be insignificant in the next stand if (1) all diseased residuals or advanced regeneration is destroyed during logging, (2) only pine and larch are planted or allowed to regenerate in stands with laminated root rot, and (3) all mistletoe-infected or root-diseased trees adjacent to clearcuts are removed or destroyed to prevent dwarf mistletoe infection of susceptible trees within the unit and minimize windthrow around the unit.

The information and recommendations presented in this report have been specifically formulated for the area we surveyed. Although some of this information may be applied to other areas in Oregon and Washington experiencing similar forest pest problems, these areas may be sufficiently different from the area that we surveyed to warrant a separate biological evaluation to formulate specific management alternatives. FPM pathologists and entomologists encourage and are available to perform such evaluations at the request of land managers.

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